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Montana Department of Agriculture
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Field Evaluation of Chlorophacinone Treated Bait for Management of Columbian Ground Squirrels

By

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ABSTRACT

Field trials were conducted to determine the efficacy of multiple applications (two applications at a 48 hour interval) of chlorophacinone treated squirreled oat groats on Columbian ground squirrels in western Montana. Two concentrations of chlorophacinone (25 ppm and 50 ppm) were tested using two methods of application (mechanical broadcast and spot baiting by hand). No significant differences in efficacy according to application method were observed. Effectiveness of the 50 ppm concentration was better than the 25 ppm bait formulation. Neither bait formulation was judged acceptable for long term, economical control of the Columbian ground squirrels under Montana conditions.

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INTRODUCTION

Interest and use of chlorophacinone baits for field rodent control has expanded since the anticoagulant received EPA registration for use on commensal rodents. Presently, chlorophacinone is registered federally either under Section 3 or Section 24(c) for voles (Microtus spp), pocket gophers (Thomomys spp and Geomys spp) and ground squirrels (Spermophilus spp). This compound is classified as a multidose anticoagulant which requires several feedings by the target rodent over a 3 to 5 day period in order to be lethal. To be effective for ground squirrels, bait must be presented in bait stations or broadcasted on the target area every other day for three to four applications.

These methods of application are labor intensive, use large quanities of bait and are most applicable for protection of high value crops. These high cost methods cannot be economically applied to crops such as pasture, forage or small grains which are the major crops in Montana. Traditionally, in Montana, these crops have been protected from ground squirrel damage by single applications of acute rodenticides such as strychnine and Compound 1080. Cancellation and/or restriction of these rodenticides has made the development of effective alternatives necessary. Spot baiting or broadcast application of chlorophacinone baits could be an acceptable alternative for ground squirrel control if the rate of bait application and the number of applications made could be reduced while retaining efficacy.

STUDY OFJECTIVE

The objective of this study was to determine the efficacy of two concentrations of chlorophacinone bait (25 ppm and 50 ppm) applied by two application methods (hand spot baiting and mechanical broadcast) for population reduction of the Columbian ground squirrel (Spermophilus columbianus).

STUDY AREA

Nine study plots (8 treatment,1 control) were selected from a dryland pasture occupied by ground squirrels near Deer Lodge, Powell County, Montana. The pasture had been grazed during winter and spring but no livestock were present during the study. Plots used for mechanical broadcast application were selected from areas of relatively flat terrain and sparse vegetative cover.

Temperatures during the study period averaged 41.4 F for the low and 83.3 F for the high. Temperatures ranged from lows of 29^o to 56^oF to highs of 73^o to 94^oF. No measurable precipitation fell during or immediately after bait application to the study plots.

Several rain showers occurred during the study period totaling 1.09 inches. This moisture and the generally warm days contributed to significant increase in vegetation height on the study site during the study period.

METHODS

Two concentrations of chlorophacinone bait were tested (0.0025%, 0.005%). All baits were formulated using squirreled oat groats (hulled, slightly rolled) as the carrier. Bait was applied to each study plot twice with a two day interval between applications using the same application method.

Two application methods were used for each bait concentration (spot baiting by hand and mechanical broadcast) resulting in four different combinations of bait concentration and application methods. Each test was replicated once. One additional study plot established as a control received no bait application.

Bait was applied by hand using calibrated dippers which contained 9 grams of bait. One dipper of bait was scattered near each active ground squirrel burrow on the study plot. Bait was broadcast mechanically using a motor-driven seeder mounted on an ATV 3-wheeled motorcycle. The seeder was calibrated to apply 6 pounds of bait per acre. Bait was applied in adjacent 30 foot swathes over the study plots. The number of kernels of bait applied averaged 3.75 kernels/sq.ft.and ranged from 0 to 9 kernels/sq.ft.

Plots for broadcast treatment were selected in areas of light or sparce vegetative cover and moderate terrain. Broadcast application plots were sampled posttreatment to determine the average percent of ground cover. Average percent ground cover was determined by taking 10 random samples using a square(1 sq.ft.). Percent ground cover from each sample was estimated visually, totaled, then averaged to give an estimate of percent ground cover on each study plot.

Bait acceptance by the ground squirrels was tested prior to bait application on two sites typical of the general study area. Untreated oats were placed at 20 locations on each site. Oat consumption was checked after two days. Consumption of 80 percent of the oats was judged adequate to begin application of the toxic bait.

Efficacy was measured by using visual counts and active burrow counts to determine reduction in squirrel activity. Visual counts consisted of three counts using binoculars at five minute intervals each day for three consecutive days, pretreatment and posttreatment. Percent reduction in activity using visual counts was calculated using the following formula.

$$\text{Percent Reduction in Activity} = 1 - \frac{\begin{array}{c}\text{No. Squirrels Counted}\\ \text{posttreatment}\\ \text{(Treated Plot)}\end{array} \times \begin{array}{c}\text{No. Squirrels Counted}\\ \text{Pretreatment}\\ \text{(Control Plot)}\end{array}}{\begin{array}{c}\text{No. Squirrels Counted}\\ \text{Pretreatment}\\ \text{(Treated Plot)}\end{array} \times \begin{array}{c}\text{No. Squirrels Counted}\\ \text{Posttreatment}\\ \text{(Control Plot)}\end{array}} \times 100$$

Active burrow counts were conducted by flagging a minimum of 50 active burrows per study plot and closing them with soil, pretreatment and posttreatment. The number of burrows reopened were counted 2 days after closure. The same burrows were used throughout the study. Percent reduction in active burrows was calculated using the following formula.

$$\text{Percent Reduction in Active Burrows} = 1 - \frac{\begin{array}{c}\text{No. Holes Reopened}\\ \text{Posttreatment}\\ \text{(Treatment Plot)}\end{array} \times \begin{array}{c}\text{No. Holes Reopened}\\ \text{Pretreatment}\\ \text{(Control Plot)}\end{array}}{\begin{array}{c}\text{No. Holes Reopened}\\ \text{Pretreatment}\\ \text{(Treatment Plot)}\end{array} \times \begin{array}{c}\text{No. Holes Reopened}\\ \text{Posttreatment}\\ \text{(Control Plot)}\end{array}} \times 100$$

Searches for target and nontarget carcassess were conducted throughout the posttreatment period. The number and fate of each carcass was recorded. Carcasses found in good condition were collected for analysis of chlorophacinone residues.

RESULTS AND DISCUSSION

The bait acceptance tests conducted prior to bait application showed complete consumption of all the untreated oats at each test spot after two days. Approximately 80 percent of the bait was consumed on the hand baited plots one day after the first toxic bait application. All the bait was consumed after the second day. Consumption of the bait on the hand baited plots was near 100 percent one day after the second toxic bait application. The broadcast baited plots were not monitored for bait consumption.

We found 18 ground squirrel carcasses on the study area, 11 on the 50 ppm plots and seven on the 25 ppm plots. Six carcasses were collected for residue anaylsis, five carcasses had been scavenged by birds and seven were scavenged by carrion-eating insects (Blow Flies-Calliphoidae, Flesh Flies-Staphylinidae, and Carrion Beetles-Silphidae) with no apparent consumption by either birds or mammals. Only two moribund squirrels were observed. Two long-tailed weasels (Mustela frenata) carcasses were found. One was found with no external signs of trauma and collected for residue analysis. The second had been degraded to skin and bone by insects and cause of death could not be determined.

Several changes occurred during the study which make a straight forward interpretation of the efficacy data difficult.

1.) Vegetation height increased significantly between pretreatment and posttreatment censuses.
2.) Color of the study plot vegetation, especially a tall mustard (Cruciferae), changed from a predominately green to a pale yellow and rusty brown.
3.) Heavy rains from thunderstorms may have opened some of the closed burrows posttreatment on the study plots.
4.) Squirrel activity decreased on the control plot: 60 percent decrease using visual counts and 22 to 38 percent decrease using burrow closures (Table 1).

The change in vegetation height and color reduced the posttreatment visibilty of ground squirrels on the study plots. Had the vegetation remained substantially unchanged, we believe posttreatment visual counts would have been higher than those recorded resulting in higher activity indices or lower efficacy. When counting reopened burrows after the intense rain showers, it was often difficult to judge if the burrows were opened by rainwater or by ground squirrels. When in doubt we attributed open burrows to ground squirrel activity. This may have resulted in higher activity indices or lower efficacy than actually occurred. The cause of the decrease in activity on the control plot is unknown. We assumed that changes on the control plot reflected similar changes occurring on the treatment plots. If the reduction in activity on the control plot was unique and did not occur on the remainder of the study area, the percent reduction in activity would be higher for all treatment plots.

Despite these factors general conclusions can be made based on the data shown in Table 1. Efficacy using the 50 ppm bait was higher than when using the 25 ppm bait. On July 19, 1986 (14 days posttreatment) percent reduction in activity was 92.6 percent (visual counts) and 63.0 percent (burrow counts) when data from the four 50 ppm plots were combined compared. This compares to 69.8 percent (visual counts) and 52.1 percent (burrow counts) for the combined 25 ppm plots. We believe the visual census method over estimated efficacy and that the burrow closure census method likely underestimated efficacy with the actual result somewhere between. A simple average between the two census methods giving each equal weight yields an estimate of

TABLE 1. Percent Reduction in Activity in Columbian Ground Squirrels Using Chlorophacinone Baits.

		Date 7/2/86*			Date 7/9/86*		
		Census Method			Census Method		
	Plot No.	Visual	Burrow		Visual	Burrow	
Broadcast (50 ppm)	1	89.5	76.0		94.7	37.0	
Broadcast (50 ppm)	2	95.3	65.4		95.3	89.7	
Hand Bait (50 ppm)	3	90.9	79.0		88.7	76.1	
Hand Bait (50 ppm)	4	91.6	81.4		92.6	50.3	
Broadcast (25 ppm)	5	59.6	47.5		82.7	48.0	
Broadcast (25 ppm)	6	44.5	55.2		67.2	82.0	
Hand Bait (25 ppm)	7	40.0	53.6		50.2	44.2	
Hand Bait (25 ppm)	8	46.8	24.7		60.0	33.1	
Control	9	60.0	22.0		60.0	38.0	
	Combined Plots			Ave			Ave
Broadcast	1-2	92.6	70.7	81.7	95.0	63.8	79.4
Hand bait	3-4	90.9	80.2	85.6	90.9	63.1	77.0
Broadcast	5-6	51.5	51.6	51.6	74.4	66.8	70.6
Hand Bait	7-8	44.1	38.6	41.4	56.1	38.4	47.3
50 ppm	1-4	92.6	75.4	83.5	92.6	63.0	77.8
25 ppm	5-8	49.7	45.0	47.4	69.8	52.1	61.0

* 7/2/86 and 7/9/86 are 7 and 14 days posttreatment, respectively.

77.8 percent and 61.0 percent reduction in activity on the 50 ppm and 25 ppm plots, respectively.

Results of samples to determine the average percent ground cover on the broadcast application plots are shown in Table 2.

Table 2. Percent ground cover on mechanical broadcast application study plots.

Plot No.	1	2	3	4
% Ground Cover	60.0	22.5	45.0	67.5

The data (Table 1) indicate that the method of application did not make any dramatic difference in efficacy achieved. Census data showed the broadcast plots achieved higher efficacy on three of the four combined study plots on July 2, 1986 and on all four of the combined study plots on July 9, 1986. This indicates the squirrels were able to locate sufficient quanities of bait that had been broadcast at the rate used in this study to give efficacies equal to or better than spot baiting by hand.

Broadcast application by a terrestrial spreader will be limited to areas of moderate terrain. Efficacy by broadcast application will also be reduced if attempted in areas of dense vegetation which will reduce the squirrels' ability to locate the bait.

To control ground squirrels over a long term, a control method with an efficacy at or near 100 percent is desirable. The greater the efficacy of the primary control method, the longer the recovery time for the ground squirrel population. As a result, fewer large scale control efforts are necessary or only limited control efforts are needed annually to maintain a small population. Property owners benefit by reduced costs of control efforts and prevention of crop damage. The potential for nontarget death and general environmental contamination is less because the extent or frequency of applications are reduced.

Observations of other control efforts with the Columbian ground squirrel in Montana suggest that population reductions of less than 80 percent will allow the squirrels to quickly repopulate to precontrol levels within one to two years. Based on our interpretation of the study data, we do not believe bait concetrations used at the rates of application in this study are adequate to consistantly reduce squirrel populations by 80 percent or better. A modification of the bait concentration and/or rates of application is needed to increase efficacy.

Increasing the number of bait applications to a total of three or four, thereby offering more feedings to the ground squirrels, is likely to increase the degree of efficacy into the range of 90-100 percent. An increase in the rate of application, while keeping the number of applications at two, may also increase efficacy. Both of these alternatives will substantially increase cost of control. They will unlikely be economically acceptable for control of ground squirrels on larger acreages of low value crops, even if effective.

RECOMMENDATION FOR FURTHER STUDY

The data collected in this study suggests that increasing concentration of the active ingredient increases efficacy. Increasing the concentration of chlorophacinone in the formulated bait to 75 ppm or 100ppm should increase efficacy.

We suggest field testing of chlorophacinone baits formulted at 75 ppm and 100 ppm to determine their efficacy on the Columbian ground squirrel and other species. If these concentrations provide satisfactory levels of efficacy, we would encourage and support any additional data collection needed to meet registration requirments for Section 24(c) [short term] and Section 3 registrations of chlorophacinone baits for use in field rodent control.

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